abstract, drawings, and claims have been amended to correct typographical errors and to satisfy the objections of the Examiner.

In the Office Action dated September 10, 2002, claims 1-7 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite; claims 1 and 2 were rejected under 35 U.S.C. § 103(a) as being unpatentable over JP 07-031841 ("Hiroo"); claims 1 and 4 were rejected under 35 U.S.C. § 103(a) as being unpatentable over JP 08-000950 ("Tamaru"); claim 3 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Hiroo or Tamaru in view of US 3,825,286 ("Henry") and US 3,005,369 ("Koster"); and claims 5-7 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Hiroo or Tamaru in view of US 5,403,522 ("Von Berg"). These rejections are respectfully traversed.

Rejection under 35 U.S.C. § 112, second paragraph

Claims 1-7 were rejected as being indefinite. These claims have been modified in accordance with the Examiner's concerns with a few exceptions. The statements regarding various features lacking proper antecedent basis because the feature "is merely recited in the preamble of the claim" is not understood as such provides proper antecedent basis. While the term "wet" may or may not be a relative term, the claimed recitation "wet-gas desulfurizing" is not a relative term and is believed to be definite to one of ordinary skill in the art. The recitation "configured as a semicircular trough" is also believed to be definite.

Rejections under 35 U.S.C. § 103(a)

Claims 1-2 were rejected as being unpatentable over Hiroo. Hiroo discloses that the discharge end of the discharge tube 12 opens at the wall of the absorption tower 1, but not into the absorption liquid provided in the absorption tower 1. With this configuration of Hiroo, the dispersed air bubbles have less contact with the absorption liquid in the absorption tower 1, and cannot efficiently oxidize the absorption liquid compared to the claimed invention. As set forth in amended claim

1, the discharge end of the branch pipe opens into the absorption liquid, rather than the wall of the collection tank. This feature is specified in claim 1 by the limitation "said branch pipe extending into a collection tank through a wall of said collection tank and having a discharge end, which discharges the circulating absorption liquid into the absorption liquid in the collection tank".

Further, Hiroo is silent as to the specific location of the air mixer 9. If the distance between air mixer 9 and the discharge end of the discharge tube 12 is too short, then the turbulent zone will not be stablized by the time the flow reaches the discharge end of the discharge tube 12. On the other hand, if the distance between the discharge end of the discharge tube 12 and the air mixer 9 is too long, then the dispersed air bubbles in the absorption liquid caused by the air mixer 9 will disappear before they reach the discharge end, and the effect of the claimed invention to oxidize the absorption liquid will not be attained.

It is, therefore, important to the claimed invention to specify the position to mix the air, such a specification is not obvious. In amended claim 1, the position to mix the air is set forth by the limitation: "said air-blowing pipe having an end inserted into said branch pipe at an insertion point located between 3D and 10D from the discharge end of said branch pipe". This limitation is an important feature of the claimed invention as it serves to maximize the efficiency of oxidizing the absorption liquid. The specification at the last paragraph of page 7 through the first paragraph of page 8 sets forth the following:

> In this configuration, then, if the pipe which circulates the absorption liquid has a diameter D, the air pipe is connected to it at a point which is between 3D and 10D from the end of the branch pipe. As a result, the cavity of negative pressure in the branch pipe which is caused by the injection of the air is stabilized by the time the flow reaches the end of the pipe. The injected air goes into the collection tank in the form of tiny, uniformly dispersed bubbles which efficiently oxidize the absorption liquid.
>
> If the air pipe is connected more than 10D from the end of the branch pipe, the bubbles resulting from the liquid-vapor interface will disappear, and the effect of the invention will not be fully attained.

Therefore, the claimed invention defines a critical feature where the applied art is silent.

Claims 1-4 were rejected as being unpatentable over Tamaru. Tamaru is silent as to the air-blowing pipe being inserted into the branch pipe at an insertion point located between 3D and 10D from the discharge end of the pipe 12. Tamaru discloses that air can be mixed for generating a "foam", but do not disclose how to generate the "foam" efficiently. As stated above and in claim 1, the air mixing point is defined by the limitation: "said air-blowing pipe having an end inserted into said branch pipe at an insertion point located between 3D and 10D from the discharge end of said branch pipe". The location of the insertion point is important for maximizing the oxidization of the absorption liquid. Tamaru's silence on this limitation cannot support the conclusion that such would have been an obvious modification at the time the invention was made to a person having ordinary skill in the art.

Claim 4 depends from claim 1, and should be allowed for the same reasons as claim 1, and additionally because it recites a pipe diameter of about 0.4D to 0.7D.

Claim 3 was rejected as being unpatentable over Hiroo or Tamaru in view of Henry and Koster. Hiroo and Tamaru are silent as to the air-blowing pipe being "configured as a semicircular trough facing downstream toward the collection tank". Henry discloses a joint configuration of primary pipe 41 and secondary pipe 47 facing downstream, however, the secondary pipe 47 is not inserted into the primary pipe 41 as is required by the claimed invention. Koster discloses tubes 11 and 12, yet tube 12 is not inserted into tube 11 as is required by the claimed invention.

Claims 5-7 were rejected as being unpatentable over Hiroo or Tamaru in view of Von Berg. Von Berg discloses a nozzle 46 provided in pipe 32. Von Berg, at column 5, lines 14-21, sets forth the following: "The discharge locations 72 and 74 are formed by a plurality of circumferentially spaced discharge slots 76 formed in the side wall 48 of the nozzle 46 and extending downstream toward the outlet end

52 which has a central aperture 78 defined by the free ends or tips of a plurality of land portions 82 separating each adjacent pair of discharge slots 76."

According to a JSME Mechanical Engineering Dictionary, published on August 20, 1997, a nozzle is distinct from an orifice. In the dictionary, a nozzle is defined as a pipe that gradually changes a diameter of a pipe in order to accelerate the speed of liquid or gas flowing in the pipe. In contrast, an orifice is a choke or a slot that generates a flowing resistance in the pipe. The claimed invention recites an orifice, not a nozzle, for the purpose of constricting the flow of the absorption liquid at the constricted areas 3c. Therefore, the Von Berg is insufficient.

Withdrawal of the rejection of claims 1-6 is respectfully requested.

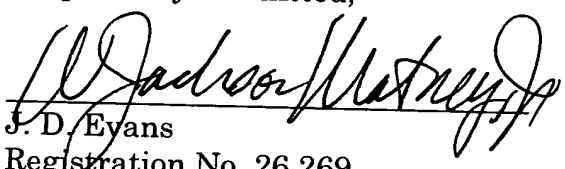
In view of the foregoing amendments and remarks, the application is respectfully submitted to be in condition for allowance, and prompt favorable action thereon is earnestly solicited.

If there are any questions regarding this amendment or the application in general, a telephone call to the undersigned would be appreciated since this should expedite the prosecution of the application for all concerned.

If necessary to effect a timely response, this paper should be considered as a petition for an Extension of Time sufficient to effect a timely response; please charge any deficiency in fees or credit any overpayments to Deposit Account No. 05-1323 (Docket #1684/48707).

Respectfully submitted,

January 10, 2003



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MARKED-UP VERSION TO SHOW CHANGES

IN THE SPECIFICATION

Please delete the paragraph on page 5, lines 1 to 8, and replace it with the following paragraph:

The air [10] used for oxidation may be blown into liquid 11 as it is being conducted to the bottom of tank 102, or it may be introduced in pipe 110b and brought into contact with the liquid containing a high concentration of SO_2. This will speed up the oxidation reaction. The air [10] can be distributed uniformly throughout tank 102 in the form of tiny bubbles which escape through pinholes 111a on the bottoms of a traylike array of pipes 111.

Please delete the paragraph on page 8, lines 21 to 26, and replace it with the following paragraph:

As can be seen in Figure 4, the cavity point of the boundary layer for the cut-off portion 4a of the air pipe is fixed. Therefore, the pressures of both liquid [11] and air [10] are stabilized. And the fact that the open portion 4a of the pipe is large will mean that the air pressure exiting the pipe is reduced.

Please delete the paragraph on page 15, lines 18 to 24, and replace it with the following paragraph:

In this embodiment, then, the end 4a of air pipe 4 is half cut away. Its rear portion 41, which faces the current in branch pipe 3, is streamlined. Its surface or cavity 41a, which is shown in Figure 4 and faces downstream, is cut away to form a large opening across the entire width of the pipe. Thus the air in branch pipe 3 stabilizes the cavity and minimizes pressure fluctuations in the liquid. Erosion of the pipe is suppressed.

Please delete the paragraph on page 16, lines 8 to 16, and replace it with the following paragraph:

Figures 5 and 6 illustrate the configuration of the third preferred embodiment of this invention. Figure 7 (A) illustrates what goes on in branch pipe 3 just before liquid-vapor mixture 12 is formed from the air admitted via air pipe 4 and absorption liquid 11, which is passing from the constricted state it experienced in negative pressure region 6, the region created by orifice 5 having a diameter d, to an expanded state. Figure 7 (B) illustrates how the pressure changes in negative pressure region 6.

Please delete the paragraph on page 16, lines 23 to 29, and replace it with the following paragraph:

Branch pipe 3 branches downstream from circulation pump 53, which is in distribution pipe 55, as is shown in Figure 15. Branch pipe 3 is extended into collection tank 2. The absorption liquid is discharged and circulated into the tank from the end 3a of branch pipe 3. The orifice 5 is created in a straight portion of branch pipe 3 upstream from end 3a. Air pipe 4 opens into the negative pressure region 6 created by the orifice 5.

Please delete the paragraph on page 16, line 30 to page 17, line 6, and replace it with the following paragraph:

The air pipe 4[a] should be installed (i.e., it should introduce air) at a point which is between 3D and 10D upstream from the end 3a of branch pipe 3. The air 10 to be used for oxidation is automatically sucked from air pipe 4 using the suction generated in negative pressure region 6. The cavity eddies generated in region 6 pick up the air so that by the time liquid 11 has passed from its constricted to its expanded state, the air is confluent with it, thus forming a confluent liquid-vapor mixture 12.

Please delete the paragraph on page 17, lines 7 to 19, and replace it with the following paragraph:

As can be seen in Figures 7(A) and 7(B), the absorption liquid 11 which passes through the orifice 5 begins to expand after generating negative pressure region 6. The instantaneous pressure reaches point 7 and reverts to its original pulse state. During this period, the air 10 which is sucked in forms a liquid-vapor mixture 12, in which the air converts to tiny bubbles as it shears. This mixture is discharged into collection tank 2 through the end 3a of branch pipe 3 in the form of a jet. Once the jet has conveyed the mixture to a given location in collection tank 2, a rising current is generated. This keeps the collected liquid in a constant state of agitation, providing excellent oxidation and preventing any sediments created by oxidation from accumulating.

IN THE CLAIMS

1. (amended) A wet-gas desulfurizing apparatus which removes [[the]] oxides of sulfur[, such as SO_2] from combustion exhaust gas by scrubbing the combustion exhaust gas with an absorption [liquidwhich] liquid which contains an alkali, said apparatus comprising:

a branch pipe for circulating the absorption liquid, said branch pipe extending into a collection tank through a wall of said collection tank and having [an] a discharge end, which discharges the circulating absorption liquid into the absorption liquid in the collection tank, and an internal diameter D; and

an air-blowing pipe for injecting air into said branch pipe, said air-blowing pipe having an end inserted into said branch pipe at an insertion point located between 3D and 10D from the discharge end of said branch pipe.

2. (amended) A wet-gas desulfurizing apparatus according to claim 1, further comprising a plurality of branch pipes, wherein said branch pipe branches from a distribution pipe downstream of a circulation pump on said distribution pipe which connects the collection tank and a spraying means for spraying the absorption liquid into the combustion exhaust gas.

3. (amended) A wet-gas desulfurizing apparatus according to claim 1, wherein the end of said air-blowing pipe inserted into said branch pipe is configured as a semicircular trough facing [the] downstream toward the collection tank.

4. (amended) A wet-gas desulfurizing apparatus according to claim 1, wherein said end of said air-blowing pipe inserted in said branch pipe has an [interior] internal diameter of about 0.4D to 0.7D.

5. (amended) A wet-gas desulfurizing apparatus according to claim 1, wherein an orifice is provided in said branch pipe, upstream from said insertion point where said air-blowing pipe is inserted into said branch pipe, and said insertion point is located in a region of negative pressure created by said orifice, said region located downstream of said orifice in said branch pipe.

6. (amended) A wet-gas desulfurizing apparatus according to claim 5, wherein said orifice has a diameter which is [approximately] about 2/3 to 3/4 [that] of said branch pipe diameter.